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ABSTRACT

A multidisciplinary research team was assembled to review existing computer-aided drafting (CAD) systems for the purpose of enabling staff in the Design Drafting Department at Linn Technical College (Missouri) to select the best system out of the many CAD systems in existence. During the initial stage of the evaluation project, researchers methodically reviewed over 70 books, pamphlets, newsletters, and periodicals concerning CAD hardware and programs. After selecting 54 systems for further study, the researchers developed a 108-item evaluation instrument designed to compare each of the 54 systems according to the specific criteria for CAD performance within Linn Technical College. Based on the results of this comparison, the research team recommended that the Design Drafting Department purchase the Tektronix Plot 2D CAD system. (Appended to this report are a detailed outline of the evaluation effort, a summary of the background qualifications of the research team members, a bibliography on CAD systems, sample correspondence, minutes of the research team meetings, the evaluation instrument, and two display problems.) (MN)

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FINAL REPORT

A MULTIDISCIPLINARY RESEARCH TEAM APPROACH TO COMPUTER-AIDED DRAFTING (CAD) SYSTEM SELECTION

PROJECT NUMBER 84-131/132-600-2(076-082)(A)

SUBMITTED TO:

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MAY 3, 1984

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ABSTRACT

The proliferation of computer-aided drafting (CAD) systems created a serious problem for the Design Drafting Department at Linn Technical College. The instructors were in search of a mechanism which would provide information concerning CAD systems. The problem was compounded by the fact that there are several hundred vendors and manufacturers of CAD systems. The information available was confusing and very general. Any decision to purchase a specific system would have been little more than arbitary. Clearly what was required was a systematic approach to the problem. An approach that would allow Linn Technical College Drafting staff to: 1) methodically review present CAD systems, 2) establish criteria for CAD system performance within Linn Technical College, and 3) select the optimum system.

In order to provide the study with knowledge and leadership representing several points of view, a multidisciplinary team was assembled to perform the research. The team represented three major areas: education, industy, and the Missouri State Department of Elementary and Secondary Education (members' names and affiliations are found within the body of the report).

The team, under the direction of Ken Franken, project leader, spent many hours reviewing literature, gathering data, constructing an evaluation instrument, and ranking systems against the evaluation criteria. When possible, field research was conducted by visiting existing systems in educational and industrial settings.

The activities listed above did yield data that allowed the research team to accomplish its primary objective. A Tektronix Plot 2D system was selected as the optimum CAD unit for inclusion in the Design Drafting Division of Linn Technical College. The researchers and the institution feel very comfortable with the recommendation.

In summary, it should be noted that the recommendation to purchase Tektronix is applicable only to Linn Technical College. The recommendation is not intended to be a blanket endorsement. It is strongly recommended that each school considering the purchase of a CAD system enter into a structured study utilizing unique criteria prior to any purchase. It is hoped that the structure presented in this document will be of assistance to other institutions considering the purchase of CAD systems.

The project leader would like to thank the members of the research team for their invaluable assistance and commitment to the project goal. Special recognition should be extended to Ms. Lori Rockhill Wilson and Mr. John Elder of Westinghouse Corporation for their assistance; without their support the research would have been very difficult to acomplish.

The Problem

The Design Drafting curriculum at Linn Technical College is designed to produce graduates who have the skills and knowledge required for employment by consulting firms, construction and transportation companies, manufacturers, and public utilities.

The two year post-secondary program is comprehensive and highly technical in nature. All students are required to take support courses in mathematics and English. The first year is essentially developmental in nature, with students learning the basic elements of drafting. Second year students are involved in specific design problems in architectural, structural, and mechanical areas. In addition, students are given the opportunity to do explorative work in other drafting fields, i.e., electrical, piping, and civic.

Drafting by its very nature embraces the industrial world and reflects the scope and diversity of a changing technological society.

As an institution, Linn Technical College is committed to the teaching of that which is technologically current. This commitment is not limited to prose. Each department, including drafting, has an intimate and mandatory relationship with an industrial advisory board. This relationship serves as a conduit for information concerning trends and development in the industrial sector. In addition, instructors and administrative personnel attend meetings and seminars designed to update educational staff concerning state of the art advancements.

The Drafting department has consistently worked to upgrade and refine its curriculum and equipment. They have traditionally exceeded mandatory or minimal requirements for inservice or upgrade training. Succinctly stated, they are professional in their approach to teaching.

Until recently, drafting has been a relatively stable technology with few of the changes of a quantum nature that have assailed other fields such as electronics.

However, in the past few years, computer-aided drafting (CAD) has grown at a phenomenal rate. CAD is a system involving a computer and several electromechanical peripheral pieces of equipment. The CAD system allows a

technician to perform routine drafting tasks more efficiently, rapidly, and accurately than traditional methods. A CAD system also allows a technician to perform complex and sophisticated design problems that would be impossible to accomplish manually.

At the present time, 50 companies now offer CAD turnkey systems. By the end of 1983, it is estimated that over 100 companies will be involved in some area of CAD system hardware or software production. CAD systems will, in the near future, become the norm in drafting.

This sudden proliferation of an entirely new technology has caused some serious problems for the Design Drafting staff at Linn Technical College. They have been subjected to intense internal and external pressure to develop a CAD system for instructional purposes.

The Advisory Committee for Design Drafting indicated that the College should respond to the industrial and educational trends in CAD technology at the annual fall meeting in September of 1982. The Drafting department had already perceived the need for such a system based upon their own meetings with industry contacts and a review of professional literature. In addition, prospective students touring the school inquired about CAD systems.

It should be noted that the Drafting department decision to become involved in CAD instruction was not, and is not based on wishing to be simply part of a trend. It was, and is, based upon an increasingly large body of data that indicates that students without CAD competence will be increasingly disadvantaged in the job marketplace.

Clearly, what was required was a systematic approach to the problem. An approach that will allow Linn Technical College Drafting staff the time to: 1) methodically review present CAD systems, 2) establish criteria for CAD system performance within Linn Technical College, 3) select the optimum system.

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The Objectives

The research team was involved in the following activities in accordance with those objectives submitted in the original proposal.

Objective Number One — A Review of the Literature

Team members will research and review books, pamphlets, newsletters, and periodicals in the field to establish a common understanding of CAD function, use, and nomenclature. Team members will have reviewed at least 50 such publications by December 1, 1983. A bibliography of works consulted will be appended to the final report.

Objective Number One — Response

Team members reviewed over 70 books, pamphlets, newsletters, and periodicals concerning CAD hardware and programs. This review of the literature was invaluable in establishing a common understanding of terms, functions, and CAD nomenclature. A bibliography of works consulted is attached.

Objective Number Two — Evaluation (General)

Team members will evaluate a minimum of twenty CAD systems by January 15, 1984. This general evaluation will be conducted by rating systems against the criteria as shown elsewhere in this narrative. The general evaluation will, of necessity, be primarily based upon secondary sources. It is also anticipated that the CAD research team will be represented at various conferences and meetings throughout the State.

Objective Number Two — Response

Research team members developed an evaluation instrument (attached) and evaluated 54 systems against the criteria. This body of systems was reduced to twenty as a function of the process of rating the systems against the evaluation instrument (see attached minutes).

Objective Number Three — Evaluation (Reduced)

To have selected ten turnkey CAD systems as possible purchase choices by March 1, 1984. This activity will require on-site visitations viewing extant CAD systems, both in educational and industrial environments. This activity will focus on validating the data obtained in Objective Number Two.

Objective Number Three — Response

This objective was altered to the extent that the list of acceptable systems was reduced to 5 rather than the 10 stated in the original objective. At this point, the process of reduction became very difficult because all of the systems were excellent and similar in potential function. The team was also attempting to visit sites utilizing the remaining systems so they would not be totally dependent upon vendor published literature for information (see attached minutes).

Objective Number Four — Selection

Based upon the activities presented above, the research team will recommend a single CAD system for inclusion in the Design Drafting curriculum. That decision will be made by May 1, 1984.

Objective Number Four — Response

This objective was, in effect, the single reason for the institution to be involved in the study of CAD systems, i.e., the selection of a CAD system for use by Linn Technical College. That goal was achieved with the selection of the Tektronix system. The selection of a single system was difficult because the remaining systems were all very impressive systems. The decision to recommend Tektronix was made, not only on machine function, but also on such factors as the reputation of the manufacturer, availability of service, and amount of program material (software) available.

Population and Sample

This study was an attempt to research a minimum of 50 CAD systems. In actuality, 54 systems were studied, There is no single source that would tell the researcher how many companies were actually manufacturing CAD units. It is the researchers' best estimate that they contacted at least 70% of all CAD manufacturers. It should be noted that this is a field in a state of change and flux. Three companies who were in business when the project started had declared bankruptcy prior to the end of the research study. The salient point is that an adequate number of CAD systems were studied in order to give credibility to project recommendations.

Conclusion and Recommendations

The purpose of the research project was to select, with a high degree of confidence, a CAD system for use by the Design Drafting Division at Linn Technical College. The research methods utilized was a study team charged with that task. The team was unique because it was comprised of both institutional and non-institution persons. The two members representing industry were invaluable to the study for several reasons. First, both members (Mr. Elder and Ms. Wilson) were extremely knowledgeable in computerized design systems and the teaching of those systems. Secondly, they provided an impartial point of view concerning such topics as usage, scheduling, and learner objectives that was very beneficial.

The work done by the research team was of excellent quality. They spent many hours in formal meetings and many more hours as individuals reviewing the literature and assessing systems. In addition, team members viewed actual systems under review whenever possible.

The research activities did yield data that enabled the team to recommend the Tektronix Plot 2D System with a great degree of confidence. That system will be purchased and utilized by the Design Drafting Department for the academic year 1984-85. It is strongly recommended that other institutions considering the purchase

of a CAD system (or any expensive, complex piece of equipment) utilize a team approach in product selection. The use of specialists from industry is especially beneficial. It should again be noted that the recommendations outlined in this narrative are applicable only to Linn Technical College. Other institutions with different needs and requirements may recommend other systems.

PROCEDURES

Prior to the start of any research, a study team was formed. Members of the team and affiliations follow:

Linn Technical College Staff

Kenneth Franken, A.T. (Design Drafting) Linn Technical College; 8 years Technical and Professional Experience; Special Training: Lincoln University.

Richard Schenherr, B.S. (Mechanical Arts) Kansas State University at Pittsburg; 9 years Technical and Profressional Experience; Special Training: Lincoln University.

Ralph Keener, B.S. (Mechanical Arts) Kansas State University at Pittsburg; 15 years Technical and Professional Experience.

Robert Benne, B.S. (Electronics Engineering) Purdue University; M.S. (Electronics Engineering) Purdue University; 19 years Technical and Professional Experience; Special Training Lincoln University, U.S. Navy.

State Department of Elementary and Secondary Education

Fred Linhardt, Supervisor, Technical and Industrial Education

Industry

John Elder, Manager of Product Technology, Westinghouse, Jefferson City, Missouri. B.S. (Mechanical Engineering) University of Pittsburg; M.S. (Engineering Management) University of Missouri-Rolla; 11 years Technical and Professional Experience.

Lori Rockhill Wilson, CADAM Division, Westinghouse, Jefferson City, Missouri. B.S. (Art Education) Northeast Missouri State; A.T. (Design Drafting) Linn Technical College.

The first task was to prepare a project sequence (copy attached) outlining the tasks to be completed. Using this as a guide, the research team was then able to begin the project.

One of the first items needed was a list of CAD system vendors that we could contact for literature about their system for the team to review. A copy of the compiled list and the letter requesting the information is attached.

The first meeting of the research team was held on October 6, 1983 (minutes attached.)

The main objective of this first meeting was to establish the criteria for the CAD system. This criteria could then be used to evaluate the various CAD systems available.

The Second meeting of the team was held on November 2, 1983 (minutes attached). The main objective of this meeting was to finalize the criteria and to apply this to the literature supplied. The team selected the CAD systems to be given further consideration.

A questionnaire was developed to obtain additional information from these vendors (copy attached) and a drawing was selected to be used during system demonstrations (copy attached).

The third meeting of the research team was held on December 8, 1983 (minutes attached). The primary objective of this meeting was to complete phase three of the project outline. The list of vendors was narrowed to five and system demonstrations with these five companies was completed. A final review of these systems was completed and the final selection was made.

The fourth meeting of the research team will be held to complete phase four of the project outline which is primarily a review of project activities and the final report.

INSTRUMENTS

At the second meeting on November 2, 1984, the research team developed a questionnaire of over 100 questions to be sent to the five vendors whose systems were still under consideration. The purpose of the questionnaire was to obtain more complete and detailed information about these systems. The information obtained from the questionnaire was then used to compare the systems against a common set of criteria. A copy of the questionnaire is attached to this report.

A drawing was also developed to be used during system demonstrations. The drawing was designed to allow for comparison of system capabilities and ease of operations. Having all systems demonstrate the same drawing allowed for the evaluation of the performance of each system in the implementation of a common set of tasks. A copy of the drawing is attached to this report.

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Adage, Inc., Billeria, Maine
Applicon, Inc., Schaumburg, Illinois
Auto-Tron Technology Corporation, Denver, Colorado
Bausch & Lomb, Inc., Austin, Texas
E. Bischoff, Port Charlotte, Florida
Bruning Company, Itasca, Illinois
T & W Systems, Inc., Huntington Beach, California
California Computer Products, Anaheim, California
Calma Company, Santa Clara, California
Casconde Graphics Development, Santa Ana, California
Computervision Corporation, Bedford, Maine
Control Data Corporation, Minneapolis, Minnesota
Evans ' Sutherland Computer Corporation, Salt Lake City, Utah
Gerbert Systems Technology, Inc., South Windsor, Connecticut
Hewlett-Packard Company, Palo Alto, California
IBM Corporation, Rye, Kentucky
Information Displays, Inc., Armonk, New York
Intergraph Corporation, Huntsville, Alabama
Keuffel and Esser, Morristown, Nevada
Lockhee-California Company, Burbank, California
B.L. Makepeace, Inc., Boston, Mass.
Manufacturing & Consulting Services, Inc., Irvine, California
McDonnell Douglas Automation Co., St. Louis, Missouri
ManTech International Corporation, Annapolis, Maryland
U.S. Staedler, Inc., Canoga Park, California
Milwaukee Area Technical College, Milwaukee, Wisconsin
Megater Corporation, San Diego, California
National Institutes of Health, Bethesda, Maryland
On-Line Systems, Pittsburg, Pennsylvania
Perkin-Elmer Corporation, Oceanport, New Jersey
Pitsco, Pittsburg, Kansas
Precision Visuals, Boulder, Colorado
Prime Computer, Inc., Natick, Maine
PSI Systems Corporation, Pittsburg, Kansas

Sperry Univac, Blue Bell, Pennsylvania
Summagraphics Corporation, Fairfield, Connecticut
Tektronix, Inc., Beaverton, Oregon
Terak Corporation, Scottsdale, Arizona
Vector Automation, Inc., Baltimore, Maryland
Versatec Company, Santa Clara, California

SAMPLE CORRESPONDENCE

LINN TECHNICAL COLLEGE
LINN, MISSOURI 65051
314-897-3603

September 1, 1983

Digital Equipment Corporation
Software Referral Catalog
Engineering Systems Group, MR1-1/KL5
200 Forest Street
Malboro, MA 01752

Gentlemen or Ladies:

Please send me a copy of your Software Referral Catalog. The address is:

Kenneth Franken
Design Drafting Department
Linn Technical College
P.O. Box 479
Linn, MO 65051

Thank you for your assistance and should there be any questions concerning my request, please do not hesitate to contact me.

Sincerely,

Kenneth Franken as

Kenneth Franken
Design Drafting Instructor

KF/as

September 6, 1983

Public Information Officer
/companyname/
/address/
/citystatezip/

Dear Sir or Madam:

Linn Technical College has been awarded a grant from the Research Coordinating Unit of the Missouri State Department of Education to perform research in computer assisted drafting (CAD) systems.

A research team composed of educators and representatives from private industry will examine a minimum of twenty CAD units to determine the optimum system for purchase by Linn Technical College. In addition, the results of the study will be disseminated to other technical institutes, colleges, and area vocational schools in the state to assist them in the selection and purchase process. /companyname/ has been selected by the research team for inclusion in the study. We would like to ask for your cooperation in providing information on those topics listed below.

1. Two copies of all available advertising data concerning CAD systems produced by your company (please indicate costs).

2. Listing of Missouri schools or institutions utilizing your product.

3. Availability of after purchase training or other product support methods available (please include cost).

4. Availability of pre-purchase on-site demonstration.

5. Location of dealer-service centers in Missouri.

We would appreciate any consideration you can extend to our request. The results obtained from the study will strengthen the quality of technical education in Missouri and also inform people of the capabilities and benefits of CAD systems.

If you have any questions concerning this request or the study, please feel free to contact me (314-897-3603).

Sincerely yours,

Kenneth Franken
Senior Drafting Instructor

KF:as

/companyname/
/address/
/citystatezip/

/Adage, Inc./ /One Fortune Drive/ /Billeria, MA 01821/

/Applicon, Inc./ /1014 East Algon Quin Road/ /Schaumburg, IL 60195/

/Auto-Tron Technology Corp./ /12500 N. Washington St./ /Denver, CO 80233/

/Bausch & Lomb, Inc./ /1212 East Anderson Lane/ /Austin, TX 78752/

/E. Bischoff/ /P.O. Box 3146/ /Port Charlotte, FL 33952/

/Bruning Company/ /1800 Bruning Drive West/ /Itasca, IL 60143/

/T & W Systems, Inc./ /7372 Prince Dr., Suite 106/ /Huntington Beach, CA 92647/

/California Computer Products/ /3320 E. La Palma Ave./ /Anaheim, CA 92806/

/Calma Company/ /5155 Old Ironsides/ /Santa Clara, CA 95050/

/Cascande Graphics Development/ /1000 S. Grand Ave./ /Santa Ana, CA 92705/

/Computervision Corporation/ /201 Burlington Road/ /Bedford, MA 01730/

/Control Data Corporation/ /8100 34th Avenue South/ /Minneapolis, MN 55440/

/Evans & Sutherland Computer Corp./ /580 Arapeen/ /Salt Lake City, UT 84108/

/Gerbert Systems Technology, Inc./ /40 Gerber Rd E./ /South Windsor, CT 06074/

/Hewlett-Packard Company/ /1501 Page Mill Road/ /Palo Alto, CA 94304/

/IBM Corporation/ /900 King Street/ / Rye, KY 10573/

/Information Displays, Inc./ /28 Kaysal Court/ /Armonk, NY 10504/

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/ManTech International Corporation/ /107 Ridgely Ave./ /Annapolis, MD 21401/

/U.S. Staedtler, Inc./ /Mars CAD Div., 21034 Osborne/ /Canoga Park, CA 91304/

/Milwaukee Area Technical College/ /1015 N. Sixth St./ /Milwaukee, WI 53203/

/Megater Corporation/ /3931 Sorrento Valley Blvd./ /San Diego, Ca 92191/

/National Institutes of Health/ /Building 12A, Room 1039/ /Bethesda, MD 20014/

/On-Line Systems, Inc./ /115 Evergreen Heights Drive/ /Pittsburg, PA 15229/

/Perkin-Elmer Corp./ /Data Systems Group, 2 Cresent Pl./ /Oceanport, NJ 07757/

/Pitsco/ /1004 E. Adams/ /Pittsburg, KS 66762/

/Precision Visuals/ /6260 Lookout Road/ /Boulder, CO 80301/

/Prime Computer, Inc./ /Prime Park/ /Natick, MA 01760/

/PSI Systems Corporation/ /P.O. Box 21/ /Pittsburg, KS 66762/

/Sperry Univac/ /P.O. Box 500/ /Blue Bell, PA 19424/

/Summagraphics Corp./ /35 Brentwood Ave., P.O. Box 781/ /Fairfield, CT 06430/

/Tektronix, Inc./ /P.O. Box 500/ /Beaverton, OR 97077/

/Terak Corporation/ /14151 North 76th Street/ /Scottsdale, AZ 85260/

/Vector Automation, Inc./ /Village of Cross Keys/ /Baltimore, MD 21210/

/Versatec Company/ /2805 Bowers Avenue/ /Santa Clara, CA 95051/

LINN TECHNICAL COLLEGE
LINN, MISSOURI 65051
314-897-3603

September 23, 1983

AIDD
CAD Committee Survey
102 N. Elm Pl., Suite F
Broken ARrow, Oklahoma 74012

Ladies or Gentlemen:

I am writing to request a copy of the results of the CAD Committee's survey. Enclosed you will find the requested self-addressed, stamped envelope.

We very much appreciate your making this information available. Thank you for your time.

Sincerely,

Ken Franken, Instructor
Design Drafting

KF/as

Enclosure

LINN TECHNICAL COLLEGE
LINN, MISSOURI 65051
314-897-3603

September 23, 1983

The Harvard Newsletter on Computer
Graphics
P.O. Box 89
Sudbery, MA 01776

Ladies or Gentlemen:

Please send me any information you have available on Computer-Aided Drafting. The address is:

Kenneth Franken
Design Drafting Instructor
Linn Technical College
Linn, MO 65051

Thank you for your assistance and should there be any questions concerning my request, please do not hesitate to contact me.

Sincerely,

Kenneth Franken

Kenneth Franken
Design Drafting Instructor

KF/as

LINN TECHNICAL COLLEGE

LINN, MISSOURI 65051

Office of
Education

314-897-3603

January 9, 1984

National Center for Research in Vocational Education
Ohio State University
Columbus, OH 43210

Dear Sir or Madam:

I am writing concerning your "CAD/CAM Programs" literature which is highlighted in the November 1983 issue of the T.H.E. Journal.

Linn Technical College will be implementing a new CAD program this coming fall in our Design Drafting Division and would be very interested in receiving the above mentioned literature. The contact address is:

Mr. Kenneth Franken
Design Drafting Division
Linn Technical College
P.O. Box 479
Linn, MO 65051

Thank you for your assistance and should there be any questions concerning my request, please don't hesitate to call.

Sincerely,

Ken Franken

Ken Franken
Design Drafting Instructor

KF/as

MINUTES

A MULTIDISCIPLINERY RESEARCH TEAM APPROACH TO
COMPUTER-AIDED DRAFTING (CAD) SYSTEM SELECTION
84-131/132-600-2(076-082)(A)

PROJECT SEQUENCE/CHRONOLOGY

	TIME REQUIRED/CRITICAL DATES	RESPONSIBILITY
PHASE ONE		
1. Review of Literature		
1.1 Graphics Magazine		
1.2 S.M.E. Data		K. Franken
1.3 Manufacturers' Data		
1.4 Other		
PHASE TWO		
2. Organization (Project Team*)		
2.1 Proposal Familiarization		
2.2 Define Task		K. Franken
2.3 Review/Amend Criteria		
2.4 Establish Areas of Responsibility		
2.4.1 Recorder		
2.4.2 Research - Primary/Secondary		
2.4.3 Correspondence		
2.4.4 Other		
2.5 Establish Team Meeting Dates		
PHASE THREE		
3. The Study		
3.1 Define System Report Format		
3.2 Field Research		
3.3 Criterion Placement		
3.4 50% Reduction		
3.5 Review		
3.6 50% Reduction		
3.7 Final Selection		
PHASE FOUR		
4. Report Preparation/Submission		
4.1 Prepare Draft		
4.2 Committee Endorsement		
4.3 Final Draft (All Committee Signatory)		
4.4 Submission		

*Original Team Members plus C.P. Goforth from Waynesville and Frank Stanton from Florissant Valley

MINUTES
CAD/CAM COMMITTEE MEETING
6 OCTOBER 1983

The research team involved in the selection of a CAD system for Linn Tech met on October 6th at 9:00 a.m. with six of the seven members present. This was the first meeting of the team and the following topics were discussed.

Review of Literature

Approximately 50 companies or vendors of CAD systems have been contacted requesting information on their product for review by the team. Enclosed is the list of the companies with a check mark by those companies that have responded. A second attempt will be made to contact those companies that have not responded that the team feels need to be included.

Other published articles about CAD are being compiled for review by the team.

Proposal Familiarization

The Proposal for a Multi-disciplinary Research Team Approach to Computer-Aided Drafting System Selection that was funded by the Department of Education was reviewed by the team so that all members would be familiar with it. It was noted that Fred Lindhart was replacing Bill Goodrick for the Department of Education and that Lori Wilson from Westinghouse Company was added to the research team.

Defined Task

The task of the team as stated in the proposal is to recommend a CAD system that meets the requirements established by the team. To accomplish this, the team will need to develop a common set of requirements and a rating system as to how important each requirement is.

Establish, Review, and Amend Criteria

Although several samples of criteria were available, the team decided that the first step would be to develop the criteria to fill the needs of Linn Tech and then to compare this list with already established lists. Attached is a list of ideas discussed by the team for criteria items.

Team Meeting Dates

Because of possible time allocation problems, later is was decided to accomplish as much of the project as possible before January 1984.

It was felt that a meeting every two weeks was necessary at this time to reach that goal. Because of job responsibilities, it is necessary that the team go to evening meetings. Westinghouse offered to furnish a meeting room and the date of the October 20th at 7:00 p.m. was set. Additional meeting dates will be set at that time.

Agenda for October 20th Meeting

1. Complete the establishment of criteria
2. Develop a rating system for applying this criteria

These two items need to be accomplished before proceeding with the rest of the project.

Thank you

Ken Franken
Team Leader

CRITERIA FOR CAD/CAM SYSTEM

SYSTEM NEEDS TO BE:

If network system, then response time should be less than or equal to 1 second
Minimum number of terminals = 2 to 4 (?) scheduling? availability?
Stand alone computer as well as CAD
Fundamentals of computer graphics
Expandability - additional terminals, cost, upward capability?
First cost =
Maintenance cost =
Plotter time - (minimal) no impact on drawing time
Updates - how its handled (very easy) - low cost
Method/ease of data entry - light pen or digitizer tablet
Compiler - prefer PASCAL, FORTRAN, BASIC
Good text - documentation of how to operate terminal
Down time - 5 days maximum
On-call technical response capability
Protect individuals' work - floppy disk, hard disk - security
Backup capability
Plot capability up to C size
Must install - make operational
Portability
Instructor Training
Must see system operational prior to selection
Demo use L.T. Benchmark DWG

LIKE IT TO:

Overlay capability
Color
CAM add on
Ability to add in-house programs
Multi-line width/color

NOT IMPORTANT:

Floor space
Air Conditioning
Supply costs
Frequency of updates

CONCERNS:

Needs of Benchmark DWGS in Demo.

Number of students/instructor = 4

HDW updates - warranty, on-site?

Course curriculum

Type of keyboard

/companyname/
/address/
/citystatezip/

/Adage, Inc./ /One Fortune Drive/ /Billeria, MA 01821/

/Applicon, Inc./ /1014 East Algon Quin Road/ /Schaumburg, IL 60195/

* /Auto-Trol Technology Corp./ /12500 N. Washington St./ /Denver, CO 80233/

* /Bausch & Lomb, Inc./ /1212 East Anderson Lane/ /Austin, TX 78752/

/E. Bischoff/ /P.O. Box 3146/ /Port Charlotte, FL 33952/

* /Bruning Company/ /1800 Bruning Drive West/ /Itasca, IL 60143/

* /T & W Systems, Inc./ /7372 Prince Dr., Suite 106/ /Huntington Beach, CA 92647/

/California Computer Products/ /3320 E. La Palma Ave./ /Anaheim, CA 92806/

/Calma Company/ /5155 Old Ironsides/ /Santa Clara, CA 95050/

/Cascade Graphics Development/ /1000 S. Grand Ave./ /Santa Ana, CA 92705/

* /Computervision Corporation/ /201 Burlington Road/ /Bedford, MA 01730/

/Control Data Corporation/ /8100 34th Avenue South/ /Minneapolis, MN 55440/

* /Evans & Sutherland Computer Corp./ /580 Arapeen/ /Salt Lake City, UT 84108/

* /Gerber Systems Technology, Inc./ /40 Gerber Rd E./ /South Windsor, CT 06074/

/Hewlett-Packard Company/ /1501 Page Mill Road/ /Palo Alto, CA 94304/

* /IBM Corporation/ /900 King Street/ / Rye, KY 10573/

* /Information Displays, Inc./ /28 Kaysal Court/ /Armonk, NY 10504/

* /Intergraph Corporation/ /One Madison Industrial Park/ /Huntsville, AL 35807/

/Keuffel and Esser/ /20 Whippany Road/ /Morristown, NV 07960/

/Lockheed-California Company/ /2660 W. Empire Ave./ /Burbank, CA 91504/

/B.L. Makepeace, Inc./ /1266 Boylston Street/ /Boston, MA 02215/

/Manufacturing & Consulting Services, Inc./ /17942 Cowan/ /Irvine, CA 92714/

* /McDonnell Douglas Automation Co./ /P.O. Box 516/ / St. Louis, MO 63166/

/ManTech International Corporation/ /107 Ridgely Ave./ /Annapolis, MD 21401/

/J.S. Staedtler, Inc./ /Mars CAD Div., 21034 Osborne/ /Canoga Park, CA 91304/

✳/Milwaukee Area Technical College/ /1015 N. Sixth St./ /Milwaukee, WI 53203/

/Megatek Corporation/ /3931 Sorrento Valley Blvd./ /San Diego, Ca 92191/

✳/National Institutes of Health/ /Building 12A, Room 1039/ /Bethesda, MD 20014/

/On-Line Systems, Inc./ /115 Evergreen Heights Drive/ /Pittsburg, PA 15229/

/Perkin-Elmer Corp./ /Data Systems Group, 2 Cresent Pl./ /Oceanport, NJ 07757/

✳/Pitsco/ /1004 E. Adams/ /Pittsburg, KS 66762/

/Precision Visuals/ /6260 Lookout Road/ /Boulder, CO 80301/

/Prime Computer, Inc./ /Prime Park/ /Natick, MA 01760/

✳/PSI Systems Corporation/ /P.O. Box 21/ /Pittsburg, KS 66762/

/Sperry Univac/ /P.O. Box 500/ /Blue Bell, PA 19424/

✳/Summagraphics Corp./ /35 Brentwood Ave., P.O. Box 781/ /Fairfield, CT 06430/

/Tektronix, Inc./ /P.O. Box 500/ /Beaverton, OR 97077/

✳/Terak Corporation/ /14151 North 76th Street/ /Scottsdale, AZ 85260/

✳/Vector Automation, Inc./ /Village of Cross Keys/ /Baltimore, MD 21210/

✳/Versatec Company/ /2805 Bowers Avenue/ /Santa Clara, CA 95051/

✳ RESPONSE RECEIVED

MINUTES

CAD COMMITTEE MEETING
2 NOVEMBER 1983

The second meeting of the CAD research team was held at the offices of Westinghouse, Inc. at 7:00 p.m. with five members present. The first business was to review the minutes of the last meeting for possible revisions or additions. The committee then proceeded to the following business.

Request for Literature

Forty-two CAD vendors have formally been contacted with an introduction letter and a request for information. Twenty-seven of the vendors have now responded with two of them informing us that they were no longer in the CAD business. It was felt that this response was adequate and there was no reason to make any further attempts to contact the companies that did not respond.

Finalize Criteria

After having four weeks to study the criteria list established at the first meeting, the committee reviewed the list for possible additions or revisions. The committee felt the criteria was now complete enough to establish a method to determine how much of this criteria can be met by each system.

Field Research

An extensive list of over 100 questions was compiled by the committee to help the committee decide how much of the criteria can be met by each system. In addition to the questions, the opportunity to see the system in operation was a definite requirement. A drawing was selected to be used during the system demonstrations so there will be a common point on which we can evaluate each system.

Criterion Placement

Upon completion of the field research, the committee will then be able to place values on the criteria that each system meets to aid in the final system selection.

50% Reduction

Based on the criteria that was established compared to the literature supplied by the 25 vendors, the committee selected 11 to 12 systems for further consideration.

Meeting Date

Because of the time required to obtain the additional information from the vendors and to make arrangements for a system demonstration, there would be no need to meet until the field research is completed. If this cannot be completed by early December, then the next meeting will not be until January 1984.

CAD RESEARCH MINUTES

December 8, 1983

The third meeting of the CAD research team was held at the Offices of Westinghouse, Inc. at 7:00 p.m. with four members present and one guest (Mr. Symmonds).

Review of Minutes

The minutes of the last meeting were reviewed and no additions or deletions were needed.

Field Research

The questionnaire has been prepared and sent to the vendors of the systems that were being given further consideration. Copies of the final questionnaire have been sent to each team member. Demonstration of most of these systems have been completed.

Second 50% Reduction

A second comparison between established criteria and additional information collected on the remianing systems was completed and the list of systems to be considered further was reduced to four.

Final Selection

The committee reviewed the information again for final criterion placement of the four systems selected. Based on the results of this comparison, a final selection of the "Plot 50 2-D Drafting System" by Tektronix was made.

Report of Selection

A report with the recommendations of the committee will be prepared and forwarded to the appropriate administrative personnel. Final documentation will be completed by June 30, 1984.

Meeting Date

A meeting of the committee will be held in early 1984 for final preparation and approval of the documentation of the project.

INSTRUMENTS

1. Name, model, number, or other descriptor of you CAD system.

2. Describe a standard system configuration.

3. Date of first installation.

4. Number of installed systems in service.

5. Will you spply a listing of schools and/or companies currently using your systems?

6. Price for a one terminal system for educational institutions?

7. Maximum and recommended number of terminals per system.

8. Price per additional terminal.

9. Could an onsite demonstration be arranged?

10. Minimum recommended free disk area per user station.

11. Does system have ability to build a user drawing file from another graphics database?

12. What high level user languages(s) are supported?

13. If any, can user language(s) access the graphic database?

14. Can command files be executed? Can variables be entered at execution time?

15. Is user protected from other users?

16. Is system protected from users and from itself?

17. Can drawing file be recovered after a system crash or a power failure?

18. How does one recover from a user error?

19. Is error checking and reporting supported?

20. Can files be write/access protected?

21. Are online tutorials on the use of commands supported?

22. Is the system command syntax English-like or mnemonic?

23. Is the software for the system on a purchase or a lease basis?

23A. What is your projected frequency of updates?

23B. What would be the cost of any updates to software?

23C. Does a software package have to be purchased for each hardware system purchased or can it be copied?

24. Will routine updates to the software package affect user written code?

25. Is the system's programming language machine independent?

26. Is source code available?

27. Is software open-ended? That is, are there "plugs" for user written modules?

28. Is the system upgradable (Database compatible) with larger CAD and/or CAD/CAM systems existing or planned?

29. Can a non-active drawing be merged into an active one?

30. Does the system use wire-frame object description? If no, what representation does it use?

31. Are objects described in: 2D, 2½D, or 3D?

32. Will system generate related orthogonal views?

33. What is the maximum number of views that can be displayed at one time?

34. Which of the follwoing ar supported? (Verify, Erase, Zoom, Mirror, Copy)

35. Is entity grouping supported?

36. How extensive is the symbol library?

36A. What are the scale restrictions?

37. Specify which conics are supported.

38. What other curves, splines, etc. are supported?

39. Are surfaces supported?

40. Is semi-automatic dimensioning supported?

41. Is automatic dimensioning supported?

42. Is cross-hatching automatic?

43. Is hidden line removal supported?

44. Which geometric and mass properties calculations are supported?

45. What standards are supported?

46. How many design layers are supported?

47. Can construction be done on layers other than the main drawing?

48. Is selective brightening of layers or objects supported?

49. Is more than on line thickness available?

50. Is the system menu-driven?

51. If there is a menu, is it static or dynamic?

52. How are menu items and functions selected?

53. Do prompting and error messages share the display with the graphic image?

54. If yes, do they have their own designated area on the display?

55. What is the principal application for the system?

56. Is English to SI (metric) conversion available?

57. Are mechanical applications supported?

58. Are wiring diagrams and electrical schematics supported?

59. Are integrated circuit/printed circuit board design supported?

60. Are architectural applications supported?

61. Are civil engineering applications supported?

62. Are process plant applications supported?

63. Is automatic generation of Bill of Materials available?

64. Specify what other special purpose packages are supported?

65. Delivery time from Purchase Order?

65A. Is installation provided with purchase of a unit?

66. Is hardware warranty single source?

67. Length of hardware warranty?

68. Does the system need a controlled environment? If so, please specify.

69. Power requirements for a one terminal system.

70. Recommended floor area for a one terminal system.

71. Are multiple processors used in the system? If so, what is each used for?

72. Manufacturer of processor(s) and model number(s).

73. Range of memory size.

74. Word length in bits.

75. What is the resolution of the database?

76. Typical instruction execution speed in microseconds (s).

77. Is hardware multiply/divide supported in integer and floating point?

78. What character set is provided? How many characters are in the set?

79. Is hardware character generation standarad?

80. Number of character fonts available.

81. Is superscript/subscript capability available?

82. Describe the type of disk storage.

83. Disk storage capacity.

84. Typical disk access time.

85. Disk to memory transfer rate.

86. What is the size of the graphics system software in bytes.

87. What display technology is used?

88. Does display system utilize refresh buffers?

89. Does the terminal have intelligence?

90. Manufacturer and model number of black and white display.

90A. What is the addressable matrix?

90B. What is the viewable matrix?

90C. Is anti-aliasing hardware standard?

90D. What is the repaint/refresh rate?

90E. Does display have anti-glare coating?

90F. Are levels of gray available? How many?

91. Manufacturer and model number of color display.

91A. What is the addressable matrix?

91B. What is the viewable matrix?

91C. Is anti-aliasing hardware standard?

91D. What is the repaint/refresh rate?

92. What are the standard input devices?

93. What are the optional input devices?

94. What are the standard output devices?

95. What are the optional output devices?

96. Does the system support on line communications with other processors? Which one(s)?

97. Does the system support a low-baud configuration with a host?

98. What emulators are supported?

99. If there are regular training courses, where are they held?

100. If so, on what topics, and what is the duration and cost of each?

101. How is software debugging and problem service handled?

102. Is a hardware service contract available?

102A. What is the cost on a hardware service contract for a) a single workstation, and b) each additional workstation?

103. Is hardware and maintenance training available?

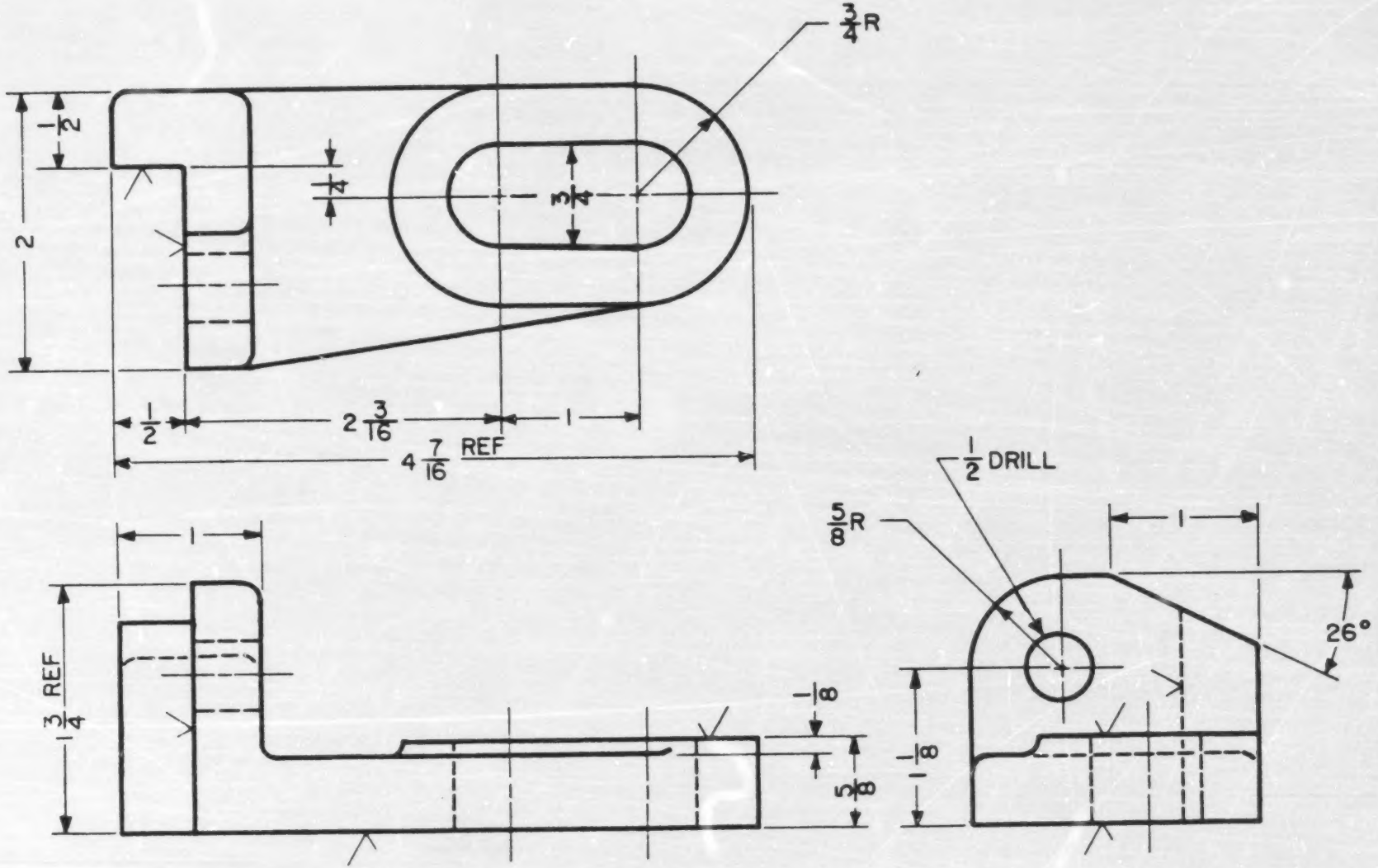
104. What manuals are supplied?

105. What is the typical response time on a service call?

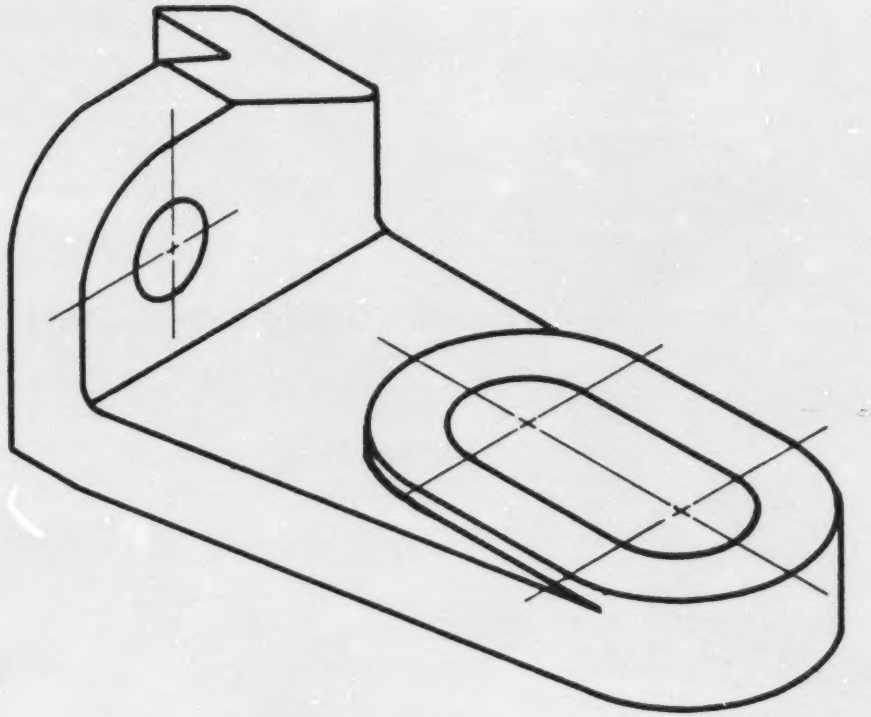
106. Are spares stocked at the customer site, at a local center, or at a national center?

107. What is the ratio of service personnel to installed systems?

108. What is the up-time average of an installed system?



ALL FILLETS & ROUNDS 1/8 R



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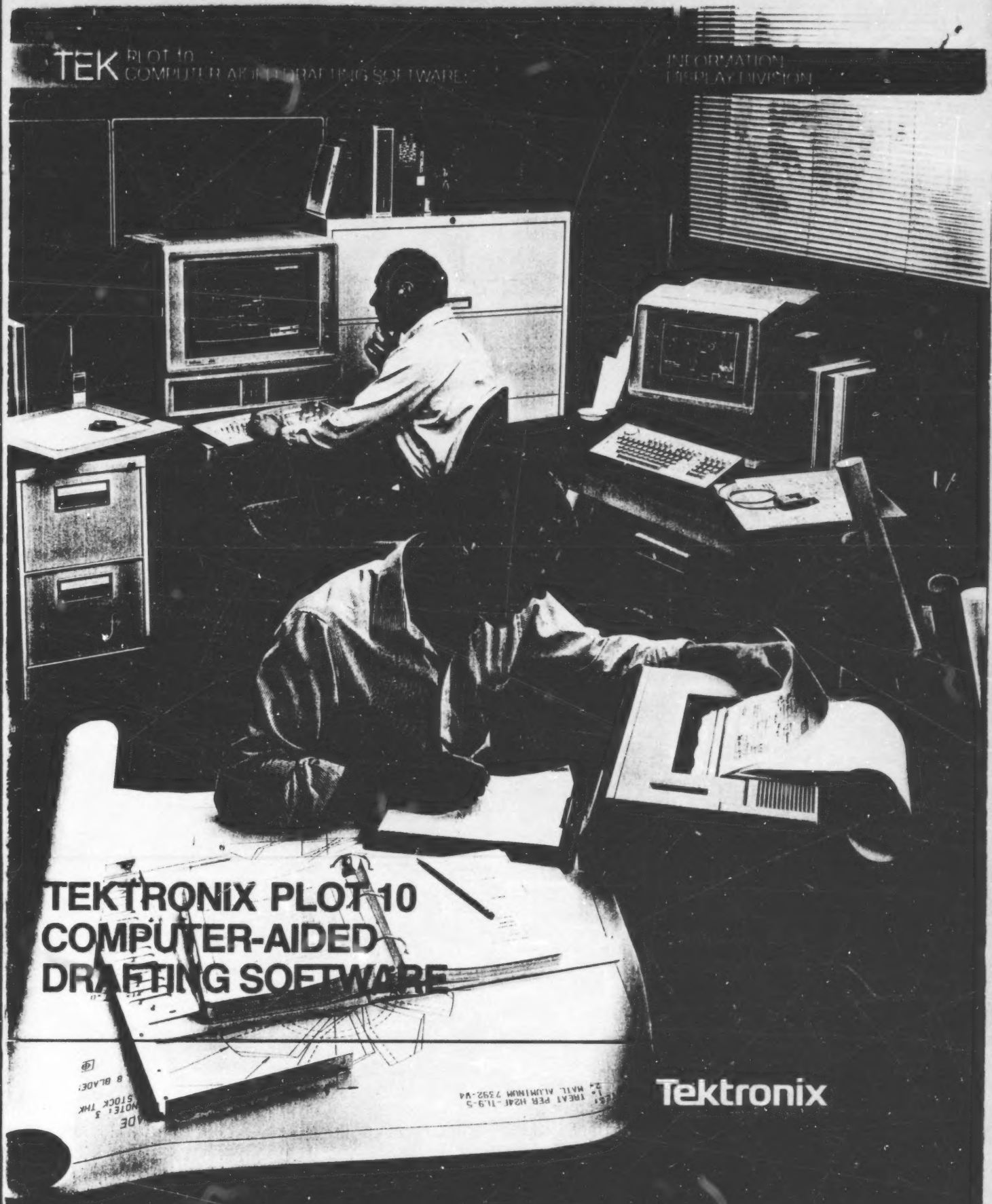
IVANKO, DAVID	DEMONSTRATION PROBLEM	11-4-83

TEK PLOT 10
COMPUTER AIDED DRAFTING SOFTWARE

INFORMATION
DISPLAY DIVISION



TEKTRONIX PLOT 10 COMPUTER-AIDED DRAFTING SOFTWARE

Tektronix